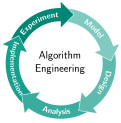
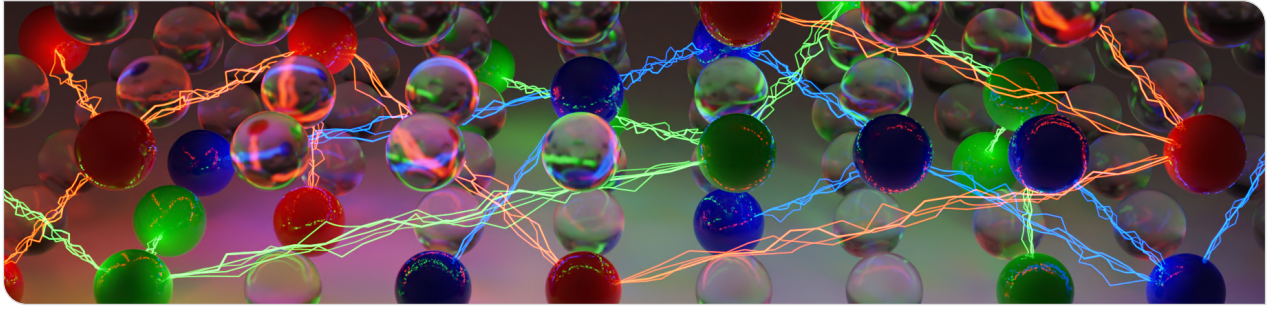
Karlsruher Institut für Technologie




# Fortgeschrittene Themen im SAT Solving

**Seminar Kick-Off**

Ashlin Iser, Dominik Schreiber | 6. November 2024



# Organisatorisches

- Ausführlicher Vortrag (30 min. + 15 min. Fragen), keine Ausarbeitung
- 2-3 Papiere aus einem gemeinsamen Themenblock einordnen, kommentieren, vergleichen
- Unterstützung und Beratung von Betreuerseite
- *n* Vortragstermine (für kleine *n*) nach Absprache

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# Topics: The Big Picture

- Which innovative paradigms for SAT solving and its extensions have emerged in the past few years?
- How can we exploit modern hardware for dependable SAT solving and its applications?
- How can we understand and exploit statistical properties of solvers and problems?

# SAT and its Extensions

## 1. CDCL and Local Search

2021, Cai et al., “Deep Cooperation of CDCL and local search for SAT”
2022, Cai et al., “Better decision heuristics in CDCL through local search and target phases”

## 2. MaxSAT

2016, Saikko et al., “LMHS: A SAT-IP Hybrid MaxSAT Solver”
2023, Ihalainen et al., “Unifying Core-Guided and Implicit Hitting Set Based Optimization”

## 3. Pseudo-Boolean Reasoning

2021, Gocht and Nordström, “Certifying Parity Reasoning Efficiently Using Pseudo-Boolean Proofs”
2024, Nieuwenhuis et al., “Speeding-up Pseudo-Boolean Propagation”

# Dependable Solving on Modern Hardware

## 4. Proofs in Parallel & Distributed SAT

2016, Heule et al., “Solving and verifying the boolean pythagorean triples problem via cube-and-conquer”
2023, Michaelson et al., “Unsatisfiability Proofs for Distributed Solvers”
2024, Schreiber, “Trusted Scalable SAT Solving with on-the-fly LRAT Checking”

## 5. Trusted GPU-accelerated SAT Solving

2024, Osama et al., “SAT Solving with GPU Accelerated Inprocessing”
2019, Osama and Wijs, “Parallel SAT Simplification on GPU Architectures”

# Data Science and Applications

## 6. Algorithm Selection for NP Problems

2008, Xu et al., “SATzilla: Portfolio-based Algorithm Selection for SAT”
2022, Heins et al., “A study on the effects of normalized TSP features for automated algorithm selection”

## 7. Future Application: Quantum Circuit Layout

2024, Shaik et al., “Optimal Layout Synthesis for Deep Quantum Circuits on NISQ Processors with 100+ Qubits”
2024, Yang et al., “Quantum Circuit Mapping Based on Incremental and Parallel SAT Solving”

## 8. Formal Explainable AI (FXAI)

2024, Paul et al., “Formal Explanations for Neuro-Symbolic AI”
2024, Marques-Silva, “Logic-Based Explainability: Past, Present & Future”